

Collaborative Quiz #1

Solutions

ECE 345/ME 380

Fall 2020

M. Dish:

(1)

$$1. I \cdot s^2 \theta(s) = -mgl \theta(s) - \tau(s)$$

$$\theta(s) [I s^2 + mgl] = -\tau(s)$$

$$\frac{\theta(s)}{\tau(s)} = \frac{-1}{I s^2 + mgl}$$

$$= \frac{-K_I}{s^2 + mgl/I}$$

$$2. s^2 + \frac{mgl}{I}$$

$$3. x_1 = \theta \Rightarrow \dot{x}_1 = \dot{\theta} = x_2$$

$$x_2 = \dot{\theta} \Rightarrow \dot{x}_2 = \ddot{\theta} = -\frac{mgl}{I} \theta - \frac{1}{I} \tau$$

$$So A = \begin{bmatrix} 0 & 1 \\ -\frac{mgl}{I} & 0 \end{bmatrix}, B = \begin{bmatrix} 0 \\ -\frac{1}{I} \end{bmatrix}$$

$$Then y = \theta = x_1$$

$$\therefore C = [1 \ 0], D = 0.$$

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3. Go to GoBoard. Take a minute to let everyone look.

1. I will ... after you return back to the main Zoom room. (Open breakout

2. Post it

while ...

Take a close look at these roles. I'll post them now in MS Teams in case you need a reminder.

GoBoard, with your team member's names.

1. $G(s) = \frac{b_1 s + b_0}{s^2 + a_1 s + a_0} = \frac{-\frac{1}{I}}{s^2 + mgl/I}$

(p) Person with highest trust in autonomy: set up GoBoard or Google Slides for team.

(s) Person with highest trust in autonomy: set up GoBoard or Google Slides for team.

$\Rightarrow b_1 = 0, b_0 = -\frac{1}{I}$

2. In a moment, I will put you in breakout rooms, in groups of 3, to discuss your answers. Each

$a_1 = 0, a_0 = \frac{mgl}{I}$

be ranked.)

4. Take a moment and think to yourself: Which of the following items are the most impor-

$A_p = \begin{bmatrix} 0 & 1 \\ -\frac{mgl}{I} & 0 \end{bmatrix}, B_p = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$

3. Let's take a look at these 8 characteristics of new hires, but together by the National Asso-

your coursework that will help you land a job when you graduate?

$C_p = [-\frac{1}{I} \ 0], D_p = 0$

3. Motivation for doing work online

\Rightarrow (d) is correct.

for groups that have an ordering.

2. $U(s) = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} s & -1 \\ +\frac{mgl}{I} & s \end{bmatrix}^{-1} \begin{bmatrix} 0 \\ -\frac{1}{I} \end{bmatrix} + 0$

vehicle the least. Has autonomy the most, and at the bottom of the list is the person who trusts the

you to do is find an ordered ranking: at the top is the person in the group who trusts the

8. I'm going to put you in breakout rooms, in groups of 3, to discuss this. What I want

the Discussion section, chapter

in the course team page. Confirm that you can see the this assignment description under

1. Please log in to MS Teams. If you need help finding the link, it's also on the left-hand menu

$= \frac{-\frac{1}{I}}{s^2 + mgl/I}$

\Rightarrow (a) is correct.

3. (b) is correct.

4. Because the ^{only} non-zero entry of \tilde{B} is in the third row, we know the input has a direct effect on $z(t)$. The \tilde{A} matrix shows that $\theta(t)$ is affected by $\dot{\theta}(t)$ (via the (1,2) element being non-zero), which is in turn affected by $\dot{\theta}(t) + z(t)$ (via the (2,1) + (2,3) elements being non-zero). Since we know $z(t)$ is impacted by the input, $\theta(t)$ is indirectly affected by the input. \therefore (a) is correct.

5.
$$\frac{J z(t_{hop})}{I} \geq \sqrt{\alpha/p}$$

$$z(t_{hop}) \geq \frac{I}{J} \sqrt{\alpha/p}$$

$J \downarrow$ means $z(t_{hop}) \uparrow$ in order to meet the hopping threshold.
 $J \uparrow$ means $z(t_{hop}) \downarrow$.

We see from Fig. 2 that higher values of $z(t_{hop})$ take longer to achieve, because $t_{hop} \uparrow$.

Similarly, $z(t_{hop}) \downarrow$ means $t_{hop} \downarrow$.

\therefore We want increased flywheel inertia J .